# Shock and Awe! Estimating Mysis Density and Catch Avoidance using the MOCNESS in SE Lake Michigan

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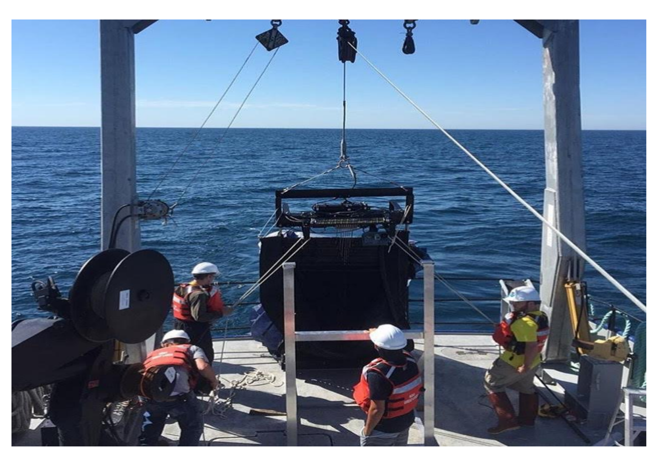
## Abstract

*Mysis diluviana (opossum shrimp)* is a key member of Great Lakes aquatic food webs and an important prey for pelagic fish. Mysis are visual predators of zooplankton, and undergo diel vertical migration from the lake bottom (day) into the water column at night. Mysis biomass estimates are highly variable but critical for food web models that inform salmonid stocking decisions. In 2016, we evaluated catch efficiency of Mysis in a Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) with LED strobe lighting that is used to sample Euphausid shrimp (krill), plankton and fish larvae in marine waters. We made replicate tows in thermally stratified depth layers during night, and compared Mysis densities sampled with the LED strobe on vs strobe off. There were no significant differences in Mysis density or size in samples with strobe on or off in any month. Mysis densities were highest in the metalimnion at night. We conclude that the strobe flash light had no effect on catch avoidance by Mysis.

## Background

**Mysis:** are cold-water shrimp-like organisms that feed opportunistically on plankton and benthos. With two stalked compound eyes, *Mysis* diel vertical migration is highly sensitive to light level and temperature.

**MOCNESS with strobe** is a Multiple Opening Closing Net, with an Environmental Sensing System plus LED strobe lights. Our MOCNESS system has 9, 1-m$^2$ nets; each net can be closed and opened independently at depth so that it samples a discrete patch of water. The MOCNESS records temperature, depth, chlorophyll, oxygen and light levels during each sample. The LED strobe lights have been shown to improve catchability of krill in marine systems (Wiebe et al. 2013)



## Research Objective and Hypothesis

- Estimate catch avoidance by Mysis in Lake Michigan at a mid depth and offshore station (M45, M110) using MOCNESS with LED strobe lights.

**We hypothesized Mysis densities sampled by MOCNESS would be higher with the LED strobe light on vs. off.**

## Methods

### *Sample Design*

- Our sampling scheme followed that of Wiebe et al. (2004, 2013) for krill aggregations in deep oceans off Antarctica and in North Atlantic Ocean.
- We conducted power analysis of Wiebe et al. (2013)'s krill density estimates to estimate numbers of replicates (n=4) needed to detect significant differences in Mysis density between strobe on and strobe off.

## Methods

### *Study Area*

Mysis were collected from S.E. Lake Michigan at a 45m site (M45) in June, and a 110 m site (M110) in July and September, 2016 (Figure 1).


***Figure 1.*** Map of sampling sites off Muskegon, MI in S.E. Lake Michigan.

### *Field Collections*

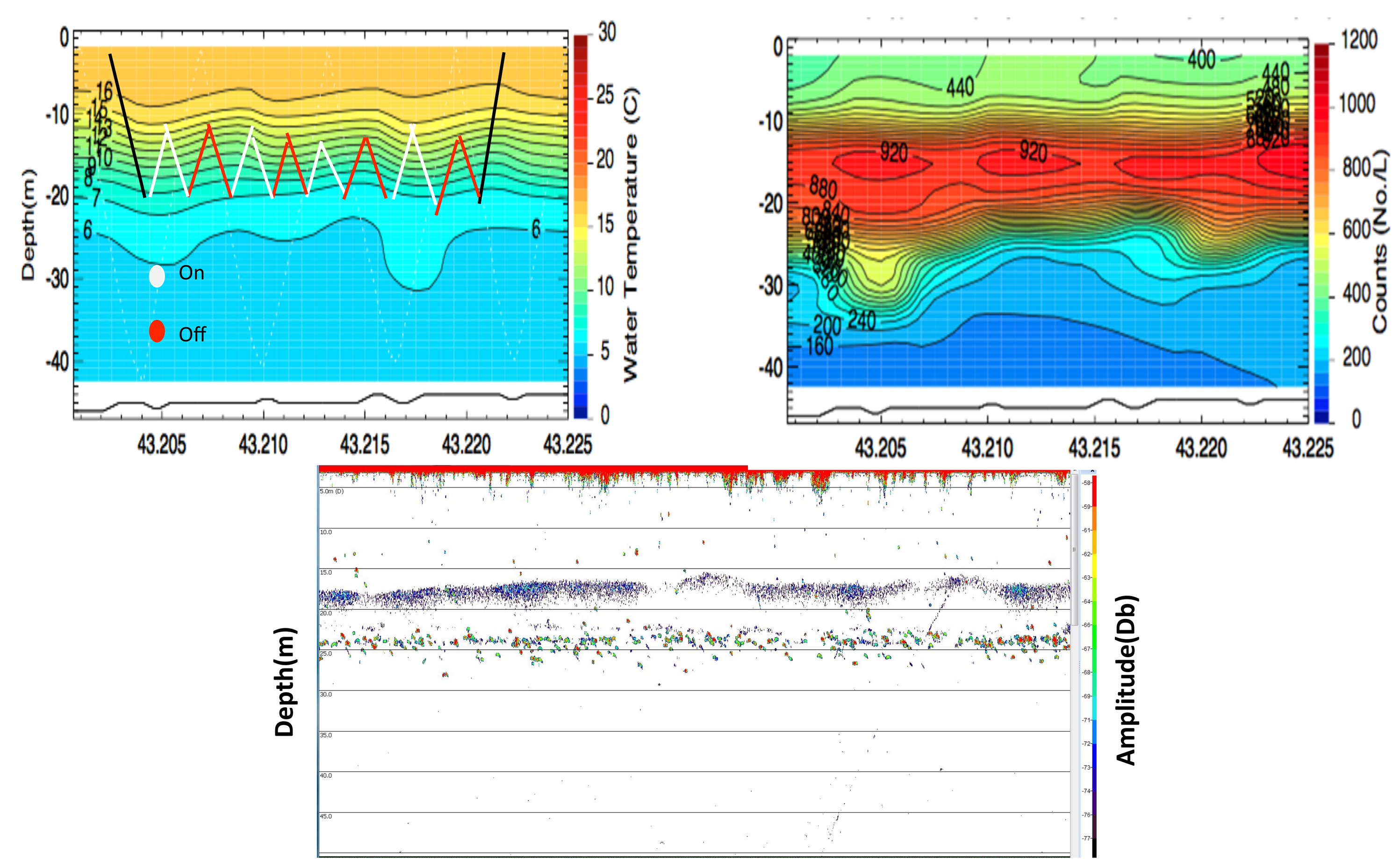



***Figure 2. Above left*** - Vertical profile of temperature at the 45 m station in July, and example of MOCNESS sample track in the metalimnion with LED strobe flash on (in white) and off (in red). ***Above right*** – Laser optical plankton counter shows highest zooplankton density in the metalimnion. ***Bottom*** - Hydroacoustics profile shows highest Mysis densities at 18m in the metalimnion (1 km screen image).

We targeted thermal strata where laser optical counts of zooplankton were high and backscatter from fisheries acoustics showed potentially high densities of Mysis.

We tow-yo'd MOCNESS nets (total number of net samples=40) for 10 minutes each within thermal strata. We randomized the on/off sequence of LED strobe lights for each net. All samples were preserved in ethanol, and Mysis were later counted and measured in the laboratory.

## Results

### *Mysis density in the water column*

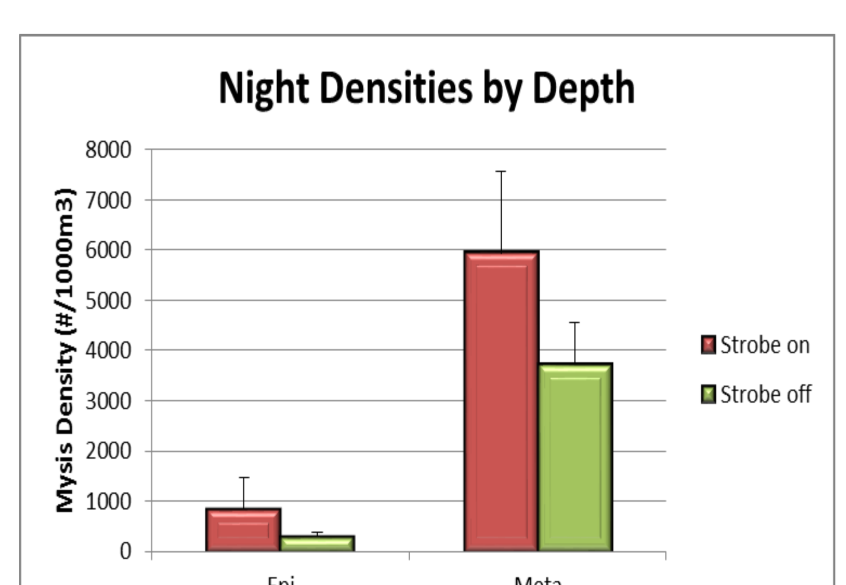



Figure 3 (left). Mysis collected at night at the 45 m site in June and the 110 m site in July indicated mean (± s.e.) Mysis density was higher in the metalimnion than in the epilimnion (p > 0.236). The hypolimnion was not sampled in either month because of lack of time.

## Results

### *Are more Mysis caught with LED strobe flash?*

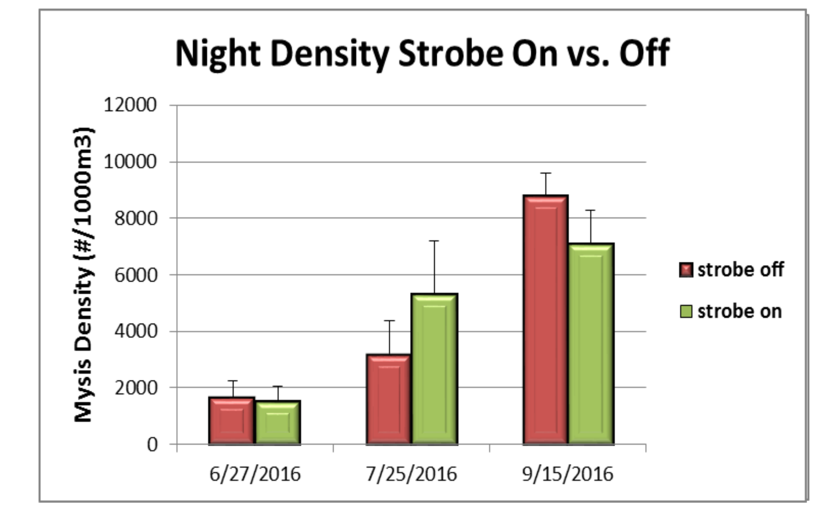



Figure 4 (left). Data from all sites and months indicate there was no significant difference (P>0.36) in mean density (± s.e.) of Mysis with strobe on or off.

### *Are bigger Mysis caught with strobe flash?*

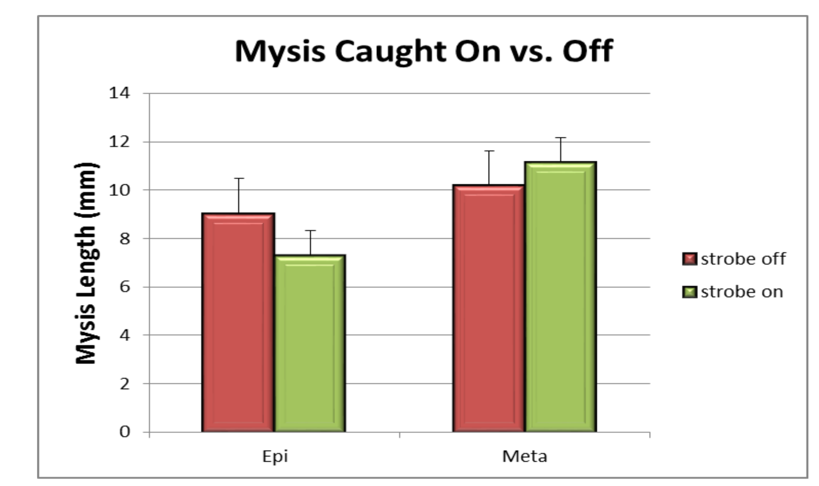



Figure 5 (left). Data from the 45 m site in June indicate there was no significant difference (P>0.53) in mean length (± s.e.) of Mysis caught between strobe on or off.

## Discussion & Future Directions

***Why no difference in Mysis density or size in nets with strobe on/off?***

- Too much ambient light!
  - We sampled on quarter and full moon phases.
  - Water clarity in Lake Michigan is higher than in oceans due to LM's lower productivity and intense filtration by invasive dreissena mussels.
  - Our sample sites in Lake Michigan were shallower and closer to shore. Wiebe et al. (2013) sampled krill in deep, remote ocean sites far from land.
- Perhaps Mysis are more light sensitive than krill.

***Why was Mysis density highest in metalimnion?***

– They migrate at night to areas of high zooplankton prey density.

### *Future Work*

- Sample during new moon. In 2016, we sampled on quarter moon (June, July) and full moon (Sept.) phase due to ship availability.
- Test whether Mysis catchability varies by LED strobe intensity, duration or pulse.
- Evaluate catchability of fish larvae in nets with LED strobe on/off. Will larval fish catchability be susceptible to strobe flash "shock and awe"?

## Literature Cited and Acknowledgments

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Wiebe, P. E., Lawson, G. L., Lavery, A. C., Copley, N. J., Horgan, E., and Bradley, A. 2013. Improved agreement of net and acoustical methods for surveying euphausiids by mitigating avoidance using a net based LED strobe light system. ICES J. Marine Science 70:650-664.

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